I claim:

1. A test apparatus for the measurement of a change in volume due to the expansion and/or shrinkage of a curable test sample during curing of the sample from a viscous to a solid state, the apparatus comprising:

a. a pressure vessel assembly housing having a sample containing portion for receiving the test sample and providing an exposed sample surface;

b. a flexible barrier seal extending across the sample surface for isolating the test sample in the sample containing portion;

c. a piston slidably mounted in a bore in the vessel assembly housing and spaced apart from the barrier seal to define a first fluid-tight chamber for receiving a volume of a first incompressible pressurized fluid medium;

d. a second chamber defined by the opposite wall of the piston and the vessel housing;

e. a pressurizing fluid reservoir external to the housing and in fluid communication with the second chamber;

f. a pump in fluid communication with the second chamber and reservoir, whereby a fluid in the second chamber pressurized by the pump exerts a corresponding pressure on a sample in the sample containing portion via the piston; and

g. a sensor assembly operably connected to the piston for measuring changes in the position of the piston resulting from the change in volume of the test sample.

2. The test apparatus of claim 1, wherein the first pressurized incompressible medium is a liquid.

3. The test apparatus of claim 1, wherein the second medium is a liquid.

4. The test apparatus of claim 1, wherein the sensor assembly includes a core

and a measuring device with a coil whereby the movement of the piston is communicated to core movement that is sensed by the coil.

5. The test apparatus of claim 1 which further includes heating and cooling means to raise and lower the temperature of the sample.

6. The test apparatus of claim 1 which further includes a controller that contains test parameters and receives and records test data.

7. The test apparatus of claim 1 further comprising a computer that includes an indicator for the initial position of the piston in the bore.

8. The test apparatus of claim 6, wherein the test parameters comprise pressure temperature, the rate of change of pressure and temperature, and time.

9. The test apparatus of claim 1, wherein the external fluid reservoir includes a reservoir fluid level indicator with markings that correlate to the change in volume of the test sample during curing.

10. A test apparatus for the measurement of the expansion and/or shrinkage of a test sample comprising:

a vessel assembly housing, one end of which includes a sample receiving portion;

a flexible seal extending across the sample receiving portion to isolate a sample placed therein from the rest of the housing;

a movable piston sealingly mounted in a bore of the vessel assembly housing and isolating a first pressurized chamber from a second pressurizing chamber in the housing, the first chamber being defined by the flexible seal and one face of the piston, the first chamber being provided with an incompressible fluid, the second chamber being defined by an opposing side of the piston and the end of the housing opposite the sample receiving portion;

a source of pressurizing fluid external to the housing and in fluid communication with the second chamber; and

a sensor assembly that is responsive to movement of the piston and an associated display and recording means for measuring the linear movement of the piston.

11. The sensor assembly of claim 10 in which a mechanical linkage extends from the piston through the second chamber to a measuring device.

12. The test apparatus of claim 11, wherein the measuring device indicates the displacement of the piston by the displacement of the pressurized fluid in response to an increase or decrease in the volume of the test sample by the displacement of the flexible seal.

13. The test apparatus of claim 10, which further includes means for heating and cooling the test sample in the vessel assembly to simulate downhole conditions.

14. The test apparatus of claim 10, wherein the piston is a floating piston that is pressure-balanced between the incompressible medium in the first chamber and the second medium in the second chamber and, the piston moves in the bore of the vessel assembly housing in direct correlation to changes in the volume of the test sample, the movement of the piston in the bore being detected by a measuring device.

15. The test apparatus of claim 13, wherein the functions of the assembly are directed by a computer integrated with the test apparatus.

16. A method for measuring the expansion and/or contraction of a curable test sample comprising the steps of:

isolating a flowable test sample in a rigid sample receiving portion of a test vessel;

securing a flexible seal over an exposed surface of the test sample;

contacting a surface of the flexible seal opposite the sample surface with a fixed volume of an incompressible pressurized liquid that is maintained in a first chamber in the test vessel by a proximal face of a movable piston that is sealingly positioned in a bore formed in the test vessel;

applying to a distal face of the piston a force by a pressurizing fluid that is contained in a second chamber in the test vessel, whereby the liquid in the first chamber and the fluid in the second chamber are isolated from each other;

measuring any movement of the piston during the curing of the sample; and

correlating the movement of the piston to a volumetric change of the sample.

17. The method of claim 16, which includes filling the sample receiving portion of the vessel assembly with a curable cement test sample.

18. The method of claim 16, which includes heating and/or cooling the test sample.

19. The method of claim 16, wherein the pressure of the pressurizing fluid is substantially constant during a test cycle.

20. The method of claim 16, wherein the step of measuring further includes detecting the amount of displacement of the piston using a LVDT.

21. The method of claim 16, wherein the step of measuring further includes transmitting the data on the change of volume of the test sample to a controller processor.

22. The method of claim 16, where the correlation of the piston's movement includes transmitting signal data to a computer for at least receiving, processing and recording test data.

23. The method of claim 16 which further includes removing any air entrained in the test sample before securing the flexible seal of this sample over the surface.

24. The method of claim 16 which further includes excluding air from the first and second chambers and from the liquid and fluid contained in said respective chambers.